Reprinted from *Contingencies: Journal of the American Academy of Actuaries*, pp. 16-23, (January/February 1999 issue). Also available as Lawrence Berkeley National Laboratory Report No. 42580.

Climate for Change
An Actuarial Perspective on Global Warming and its Potential Impact on Insurers

By Andy Peara and Evan Mills

As the debate over global warming rages, actuaries may be able to play a greater role in evaluating the merits of the opposing views and contributing to climate research itself.

Since hurricanes Hugo and Andrew, insurance companies have had to fundamentally rethink pricing, underwriting and financing for catastrophic weather-related coverage. Insurers also have had to consider whether these events were just a harbinger of things to come. If these storms presaged a changing climate, what could insurers do to prepare themselves for future catastrophes and improve their assessment of future risks?

At the Conference on Climate Change and the Insurance Industry in 1993. Frank Nutter, president of the Reinsurance Association of America, drew much attention in the insurance and environmental press. In 1995, Nutter joined officials from six other major U.S. insurance organizations to discuss climate-related threats with Vice President Gore and experts on climate change. (The other organizations included: Alliance of American Insurers, American Insurance Association, Institute for Business and Home Safety, National Association of Independent Insurers, National Association of Mutual Insurance Companies, and State Farm Insurance Companies.) Following their inquiries, they pledged to explore mitigation and sustainable energy strategies.

While these U.S. insurance groups began discussing the issue of climate change, an international coalition of major insurance and reinsurance companies was forming to address climate and environmental issues. Since late 1995, more than 81 companies from 25 countries have signed the United Nations Environmental Programme's (UNEP) Statement of Environmental Commitment for the Insurance Industry, and have publicly endorsed the necessity for action to reverse the causes of climate change. These insurers have been involved in each of the "Conferences of the Parties" meetings on climate change (Berlin, Geneva and Kyoto). Some of these insurers participated in the Intergovernmental Panel on Climate Change (IPCC) process, and authored an extensive chapter in its "Second Assessment Report." The IPCC, organized by the World Meteorological Organization and UNEP, includes over 2,500 scientists and experts from 55 countries.

Among these IPCC participants, Munich Re was the first to publicly show its concern about the climate change issue with its 1990 *Windstorm* report. Gerhard Berz, Munich Re's climate scientist, later warned that the insurance industry should not adopt the attitude that it can adjust to a changing climate. Rather, according to Berz, "it is to be feared that climate change will produce in nearly all regions of the world new extreme values of many insurance-relevant parameters that will lead to natural disasters of unprecedented severity and frequency." Berz concludes that "the insurance industry. . . must demand that political decisions are taken on climate protection immediately," and calls for "an end to the as yet completely uncontrolled 'greenhouse experiment'."

Arkwright Mutual was perhaps the first U.S. primary insurer to publicize its concerns. Arkwright's atmospheric scientist found a discernible trend toward greater flooding. He pointed out that in addition to global warming, other human activities such as river diversions, deforestation and land use exacerbate the growing risk of flood induced by climate change. Allstate has also recently issued a statement of concern about the issue. (See sidebar.)

Despite initial gestures, however, few individual U.S. insurers have become publicly engaged. Even the U.S. offices of outspoken European insurers have been largely silent. Meanwhile, the trade associations that convened with Vice President Gore in 1995 seem to have retreated into more of a “wait-and-see” stance on public policy considerations. With a few exceptions—only Employers Re and the brokerage AON are currently involved in the UNEP initiative—U.S. insurers have been notably absent from this activity.

The question of climate change, no doubt, has attracted considerable controversy. The Kyoto treaty's mandate for reduced U.S. fossil fuel consumption has not been universally popular. Several business interests have attacked the costs of the Kyoto treaty and denounced the science of global warming. Many in Congress and the media have portrayed the science of climate change as uncertain. A small but vocal minority of climate scientists either contest the underlying science of a global warming due to greenhouse gas accumulation, or see benefits to a rapidly changing climate. Their opinions have carried significant weight before several Congressional committees.

The political and economic implications of global warming research inspired the 104th Congress to significantly constrain the National Aeronautics and Space Administration’s (NASA) and the National Oceanographic and Atmospherics Administration’s (NOAA) global warming research budgets. When the House Small Business Committee heard testimony on the status of global warming research in July of 1998, Chairman Jim Talent's initial list of invitees included only greenhouse skeptics.

The IPCC has qualified several of its predictions, including those regarding extreme weather, with varying shades of uncertainty, but these uncertainties extend mostly to the timing and magnitude of the impacts of climate change.

While the handful of scientists who disagree with the IPCC's findings attract considerable attention in the popular media, the insurers in the UNEP initiative take the position that any chance of climate change is an imperative for some level of action.

When actuaries and risk managers review the information about climate change, we suggest that several statistical measures be kept in mind. The general consensus of the IPCC panel of scientists is that a human influence on climate is discernable. While climatologists cannot say with 100 percent certainty that humans are responsible for these changes, the likelihood that these events are the result of natural variation is very slight. (See Table.)

In light of the controversy, we believe actuaries and risk managers will be called upon to understand not only the more recent scientific findings about climate change, but also the differences between the more rhetorical and scientific debates. A background in statistics and modeling puts actuaries in an especially good position for understanding the analytical methods of climatology. With an awareness of climate processes, actuaries could make an important contribution not only to their clients but also to the public discussion on the topic of climate change.

Components of the Climate Change Equation

The following are capsule descriptions of some of the key forces thought to be affecting climate conditions. The relative importance of each of these forces in affecting the recent rise in temperatures is subject to debate, but few scientists deny that human activity could be a major influence:

• *Greenhouse gases* such as carbon dioxide, methane, nitrous oxides and chloro- fluorocarbons (CFCs) absorb outgoing terrestrial radiation. Atmospheric concentrations of most of these gases have increased sharply since the industrial revolution. The buildup of these gases impedes the normal flow of heat away from the earth.

• *Sulfate Aerosols* result from volcanic and fossil fuel emissions. Mixed with other gases and water vapor, they reflect incoming sunlight, which has a cooling effect on the earth's surface.

• *Devegetation* can reduce the capacity of the land to absorb CO2 and upset the ydrological balance.

• Ozone absorbs harmful solar radiation and outgoing terrestrial radiation. Ozone depletion due to CFCs has contributed to cooling in the stratosphere, but ozone accumulation in the upper troposphere due to smog has had a warming effect.

• *Solar Magnetic Cycles* extend 22 years on average and are connected with sunspot activity and the solar wind. Recent studies suggest that variations in the cycle appear to have an influence on the magnitude of incoming solar radiation, which may alter precipitation patterns.

• *Oceans* contain vast reservoirs of heat. Oceans interact with global circulation patterns, evaporation and convection of water vapor and events that produce dramatic releases of heat, such as hurricanes and El Niños.

Potential Evidence of Climate Change

Ground-based temperature indicates a warming of about 1 degree F over the past century, with numerous record-breaking extremes in 1998 alone. The warming has not been uniform. NOAA statisticians point out the 1930s were nearly as warm, but the 1980s and 1990s are unique because the current warming has happened in spite of several recent cooling influences, such as large increases in sulfate aerosols and enhanced soil moisture due to increases in precipitation. The effects of this recent warming may include:

• An increasing trend in atmospheric moisture—driven by increased temperature-related evaporation— and extreme precipitation events in the United States and Europe, according to NOAA;

• A significant increase in U.S. flood severity (Arkwright Mutual);

• Sea level rise of about 4 to 10 inches, rapid retreat of low-elevation glaciers and ice fields, permafrost melt, bark beetle attacks on ancient Alaskan forests, pole ward changes in insect migrations (IPCC, Stevens, Parmesan);

• Intensified and more frequent El Niño events. Since 1525, strong El Niño events have happened every 42 years on average, but the two strongest events, 1982–83 and 1997–98, were just 15 years apart. Normally, El Niños alternate with La Niña events, but El Niño events have dominated in the past 20 years (Quinn and Neal).

• Windstorms. The warming of oceans could alter hurricane or typhoon intensity, paths, and frequency. Some hurricane models show a decrease in activity due to countervailing atmospheric effects, while others show an increase. More important, even if average storm conditions remain the same, changes in storm paths could threaten regions where buildings have not historically been prepared to withstand them.

• Wildfire. In some regions, the sequence of greater wintertime precipitation, followed by springtime plant growth and then by hotter, drier summertime conditions increases the risk of wildfire. Some insurers have speculated that global warming is partly responsible for recent major wildfires, such as the Berkeley/Oakland Hills fire of 1991 (Swiss Re).
• Subsidence. Drought conditions cause soil shrinkage (subsidence), which can expose building foundations to damage. The Association of British Insurers reports claims of 2.5 billion pounds during the past decade, with 45,900 claims in 1997 for British insurers alone. While inflation-corrected natural catastrophe losses are up by a factor of 20 since the 1960s, actuaries have yet to disentangle the relative contributions of increased exposures due to demographic trends, reduced exposures due to mitigation efforts and changes in the frequency or severity of events.

Actuarial Science and Climatology

Climate is a generalization of weather conditions. Climatologists study the basic thermodynamic, geophysical and biological processes that contribute to temperature, moisture and precipitation, wind conditions, cloud cover and air quality. Like actuaries, climatologists rely heavily on statistics since they have limited means for experimentation; climatologists can study isolated physical properties of some weather phenomena, but no laboratory can reproduce large-scale processes. Insurance companies specializing in weather-related risks increasingly are employing climatologists. A group of insurers and reinsurers participating in the Risk Prediction Initiative in Bermuda are reviewing the foundations of climate science, hurricane risks, El Niño, and climate change. The development of weather-related catastrophe models combines the tools of both professions.

Actuaries and climatologists increasingly employ computer models to simulate future scenarios. Climatologists have developed general circulation models (GCMs) to project global climate conditions reflecting incenses in concentrations of greenhouse gases. When tested to replicate recent climate history, the first GCMs showed a warming trend that was too broad for the entire planet, but with modifications for sulfate aerosols, the models show temperature trends more consistent with actual history and spatial variations of heating and cooling.

Very recent investigations into solar magnetic variations may help account for a cooling period between the mid-1940s to the early 1970s. GCMs need improvement in terms of spatial resolution, rendition of storm tracks, cloud behavior and upper ocean characteristics.

Regardless, their ability to match contemporary climate trends is compelling enough for a vast majority of climate scientists represented by the IPCC to endorse the ranges of climate values predicted by climate models. The IPCC predicts warming of 2 degrees F to 6 degrees F by the year 2100, a sea level rise of 3 feet, and potentially significant changes in precipitation patterns and climate variability.

Modeling for Extremes and Variability

GCMs run on super computers, but lack of computing speed has limited the scope of their calculations. GCMs can produce data on average temperature, barometric pressure and precipitation for different altitudes and different seasons. This has allowed extrapolations of average characteristics, such as sea level rise, pole ward shifts in agricultural regions and species migrations, glacial dissolution and tundra subsidence. Constraints on computing power mean that the resolution scale of these models is limited to areas about the size of Oregon. This rather coarse spatial resolution prevents most GCMs from projections of extreme weather events and climate variability, which are of key importance for insurers and risk managers.

Some regional scale models have considered possible changes in extreme events and climate variability associated with changes in average temperature and precipitation. Other researchers have translated projected climate conditions into local impacts. For instance, researchers at Lawrence Berkeley National Laboratory (LBNL) and the University of Michigan have developed an impact model for predicting wildfires under global warming scenarios for various parts of California. Another LBNL modeler has simulated flood conditions in California and elsewhere. Insurers could benefit from further development of impact modeling of floods, hail, ice storms and windstorms under future climate circumstances, much as the Risk Prediction Initiative has educated insurers on hurricane risks. Similarly, climate impact modelers could benefit from insurer expertise in estimating loss potential and the efficacy of mitigation measures.

Other studies have developed statistical models of seasonal temperature distributions using mean, variance and auto correlation (the chance of one hot day following another.) These statistical models suggest that a change in mean temperature or precipitation can have substantial impacts, assuming that variance is held constant. A slight change in the mean temperature can result in a disproportionately large increase in the number of days with extreme heat. According to NOAA, "temperature distributions are roughly Gaussian. So when the highest point in the Gaussian 'bell' curve moves to the right, the result is a relatively large increase in the probability of exceeding extremely high temperature thresholds. A greater probability of high temperature increases the likelihood of heat waves."

For example, according to NOAA, a modeled 5-degree F shift in Chicago summer temperatures would increase the likelihood of a heat index of 120 (a combined measure of heat and humidity) by five times, from 1:20 to 1:4. As the chances for one day of extreme heat increase, the chances for repeated days of extreme heat increase exponentially, with severe implications for crops, ecosystems, power generation and human health. While this example is based only on a shift in mean, one must also consider the shape of these distributions. If temperature variance declines with future warming, as appears may be the case, the increased probability of extreme heat may moderate somewhat. Several studies of 20th century temperature records suggest a reduction in temperature variance in warmer periods.

While the results of climate models show various ranges of outcomes, if the warming over this past century provides any clue, additional warming may produce greater precipitation intensity, decreased day-to-day and night-to-day temperature variability and more frequent and intense El Niños.

NOAA's climatologists have already found a highly significant trend toward more intese precipitation events over the past century in the United States and Europe. Potential increases in precipitation intensity do have a strong theoretical basis. Several other nonlinear processes, such as soil saturation or snow melt, also come into play with changes in climate variability. While intense rain at any time can produce runoff, soil saturation can intensify it considerably. An erratic spell of rain or warmer temperatures can release snow pack and spur floods. Insurers could benefit from greater familiarity with models reflecting the hydrological triggers sensitive to climate changes.

Climate Science and the Public Debates

Perhaps the greatest critic of the IPCC is the IPCC itself. The IPCC rigorously documents the uncertainties associated with climate projection studies based on available knowledge. Work is underway at several climate laboratories to improve the spatial resolution of GCM ocean and atmospheric grid points, the modeling of cloud and water vapor behavior, long-term ocean circulation patterns and corresponding climatic cycles such as El Niño.

The science of global climate change has attracted considerable comment and interpretation. Challenges to the IPCC's conclusions fall roughly into the following categories:
1. Optimistic reinterpretations of data or studies on climate processes;
2. Optimistic interpretations of the impacts of climate projections on various industrial sectors and public health; and
3. Pessimistic interpretations of the costs of reducing fossil fuel consumption.

Some of the analysis skeptical of the IPCC has received academic peer review, which involves testing the quality of a researcher's analysis and conclusions. Pulitzer prize-winning journalist Ross Gelbspan has accused some IPCC critics of acting as public relations officials for their industrial sponsors by publishing non-peer-reviewed work.

Actuarial Perspectives

The complexity of climate science tends to limit the extent of public involvement in its analysis. The news media generally do a good job of explaining scientific theory and opinion, but few people have the knowledge or patience to do a thorough investigation of a scientist's analytical methods. Actuaries and risk managers, however, have not only the analytical skills to evaluate the quality of research methods, but also the commitment to understand the parameters underlying risk in as much analytical detail as necessary. The commitment to properly interpreting weather-related patterns is equally crucial. The choice of analytical method can make the difference between detecting a significant trend and finding little but noise.

Let's suppose that a medical or life insurance department requested an analysis of the correlations between projected changes in climate and human health. The request may seem a bit elusive at first, but most climate models project a general increase in the number of warm summer days with higher concentrations of greenhouse gases. Warmer seasons could expand the ranges of insects, including those of mosquitoes carrying malaria, dengue and equine encephalitis, and increase the number of days with extreme heat, such as the deadly heat spells that struck Chicago in 1995 and the southern United States in 1998.

Two studies predict very different mortality impacts due to global warming. While mortality due to extreme temperatures may affect few people who can afford life and health insurance (extreme temperature events also impact crop and electric utility revenue insurance) the following studies offer an interesting comparison of methodology: Kalkstein, L.S. and J.S. Greene, (1997): *An Evaluation of Climate/Mortality Relationships in Large U.S. Cities and the Possible Impacts of a Climate Change*. Environmental Health Perspectives, 105(1):84-93 and Moore, T., (1996): *Health and Amenity Effects of Global Warming Revised May 30, 1996*.

(Kalkstein and Greene are IPCC contributors and their study received support from the EPA. Like almost all environmental agencies around the world, the EPA views climate change as a significant environmental threat. Moore is a fellow of the Hoover Institution and is a featured contributor to the *World Climate Report,* supported by coal interests. Moore recently published *Climate of Fear: Why We Shouldn't Worry About Global Warming,* which advances his 1996 public health studies.)

The Kalkstein and Greene study suggests higher mortality rates while the Moore study argues just the opposite, with overall improvements in public health as the climate changes. Both studies examine the causes of mortality due to excess heat and cold, attributing most heat-related mortality to people with cardiovascular and circulatory disorders.

Kalkstein and Greene argue that people respond to the air mass that surrounds them, which involves temperature, humidity, cloud cover and wind speed. They examine the mortality impacts of seven categories of air masses in 44 urban areas.

The study then projects the increase in frequency and duration of these air masses under climate change scenarios from leading U.S., British and German laboratories. They adjust the results with the assumption that people will adapt in such a fashion that if New York City's average temperatures become more like today's St. Louis, then the percentage of people with air conditioning in New York City will be comparable to that in St. Louis today. They adjust results for reductions in winter mortality, and project increase in annual weather-related deaths of 1,272 to 2,735 depending on the climate scenario.

The Moore study looks more generally for correlations between mortality and statistical measures of temperature. One of Moore’s underlying premises is that any increase in mortality due to heat spells would be more than offset by a reduction in mortality due to cold spells. He produces two regression analyses of: 1) mortality vs. average annual temperature for 89 large U.S. counties for 1979; and 2) mortality vs. average monthly temperature for Washington D.C. for 1987–89, a period with hot summers.

The regression analysis indicates that mortality rates are lower in summer than winter and lower in warmer areas of the country than in cooler parts of the country. Taking the regression factors, Moore projects a relative decrease in mortality due to temperature increase. Based on 4 degree F increase in temperature, he projects a reduction in mortality of 37,000 to 41,000 per year.

If presented with a choice of analytical approach, which is the more actuarially sound? The Moore analysis makes sense if we assume 1) that future warming will render northern climates more like existing southern climates; 2) that changes in southern climates, moisture regimes and extreme weather severity will have no health consequences; and 3) that people will adapt rapidly to the changes as they occur. These assumptions are optimistic since the character of climate change will mean a climate much different for the North than currently exists in the South, extreme weather events could proliferate and intensify as we have seen with more recent El Niño events, and people might not adapt quickly to climate changes.

Moore’s approach may resemble current actuarial methodology where detailed data are lacking, but may differ in that it avoids any focused analysis of extreme heat episodes. Moore aggregates mortality statistics over longer periods on the grounds that mortality tends to decline after a killer heat wave, resulting in no net change in death rates. To demonstrate this, he compares the ratio of winter to summer deaths for a period with exceptionally hot summers (1987–89) for Washington D.C. to a prior period (1952–67) for the entire United States. In Washington, D.C., for example, the ratio in 1987–89 was 116:100; in 1952-1967 it was 113:100 for the entire United States.

Since summer mortality was lower than winter mortality for the period with hot summers (1987–89) versus (1952–67), Moore suggests that "if hot weather were detrimental to life, the differential between the summer and winter death rates should have been smaller, not larger, during the latter period." One limitation to this conclusion is that Moore is comparing two different regions. Also, by focusing on a ratio of winter to summer mortality, any analysis of summer mortality becomes subject to variations in winter mortality. The use of statistics for aggregated regions and time periods, in this case, obscures the impact of individual heat spells. If Moore’s analysis could show actual trends in gross mortality rates in a given area before, during and after a specific killer heat wave, it might lend more credence to his argument that killer heat waves have nominal effects on gross mortality.

The Kalkstein and Greene study develops a more localized assessment of the health impact of climate change for each of the 44 regions under study. In contrast to Moore’s assumption about the decline in cold temperature mortality, they cite several other studies showing that the correlation between cold temperature extremes and mortality is much weaker than the impact of extreme heat. They point to data suggesting that winter-related mortality stems in large part from respiratory ailments that pass more readily when people spend more time indoors.

Assuming that slightly warmer winters might reduce the time people spend indoors, the study takes into account that warmer winters could reduce mortality. Whereas both studies recognize that mortality rates temporarily drop after a heat-related surge in mortality, Kalkstein and Green reference statistics from actual heat waves to estimate this effect for future projections. The results of their review of past heat waves run counter to Moore's assumption that the temporary rise and fall in gross mortality are offsetting in the long term.

Integrating the Natural and Actuarial

If insurers are looking at extreme weather events, they're bound to look closely at cause and effect. An actuary generating a property insurance rate filing for coastal storms could apply a regression analysis of property claims by region across the country. Much as Moore's analysis suggests lower mortality in warmer climates, the property analysis might find higher claims along the East Coast. Property rate filings for coastal areas, however, historically have been based on much more localized analysis. Impact studies of individual storms have allowed the parameterization of their effects for future projections.

More recent catastrophe models try to simulate the impact of coastal storms of varying strength and landfall with detailed information about potential exposures, developing several claims impact scenarios for any given year. The approach taken by Kalkstein and Greene follows a similar kind of methodology by categorizing particular hot and cold spells and projecting their corresponding impacts on several future warming scenarios.

Despite Congressional resistance to the Kyoto Protocol and climate research, some insurance organizations have recognized the value of maintaining research into global warming. The Reinsurance Association of America lobbied the 104th Congress on behalf of NASA and NOAA to help maintain funding for global warming research.

Better climate research would benefit insurers as would more complete historical records of climate impact. Actuaries could play a role in assessing the financial consequences of projected climate impacts, reviewing climate impact model assumptions and considering the practicality of mitigation efforts in much the same way they informed Congress on health care and Social Security. Greater collaboration between actuaries and climate impact modelers might result in improved climate impact projections and greater public understanding of climate change. At the very least, actuaries might sharpen their estimation of climate risks.

Table

Climate Change over Past Century	**Chance of natural variation**
1) 1 deg F temperature increase globally	5-10% (IPCC)
2) 10% increase in U.S. precipitation; half of increase due to extreme events (2 in or more)	0.1% (NOAA)
3) 20% increase in U.S. area affected by extreme precipitation	0.1% (NOAA)
4) Dominant trend of El Niños in last 20 years (with few La Niñas)	0.05% (Trenberth & Hoar)

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SIDEBAR: Proactive Insurers in the United States and Overseas

Identifying a climate risk is not in and of itself a solution. Following are some of the "no-regrets" actions that proactive insurers in the United States and overseas are beginning to carry out.

• *Articulating a Corporate Policy:* Many firms have published policy statements concerning environmental issues. For example, CGU Insurance's Statement of Environmental Principles includes the concept that "As a successful commercial business, we consider the minimizing of resource use, energy use and waste production to be integral to good business practice." Storebrand and Swiss Re have issued Environmental Annual Reports, emphasizing their efforts to reduce greenhouse gas emissions.
• *Leading by Example.* Many companies have initiated efforts to manage energy in their own buildings. A number of insurers have adopted specific environmental criteria for purchasing office products and equipment. The voluntary ENERGY STAR program offered by the US Environmental Protection Agency and Department of Energy is open to American insurers and risk managers who seek technical assistance in this realm.
• *Disaster Preparedness.* Many of the losses sustained during natural disasters stem from inadequate building codes or poor code compliance. The insurance industry's Institute for Business and Home Safety has advanced a major initiative in this area that has included special training for code officials and working with ISO to implement a community-level code rating system. In another example of fostering disaster preparedness, Arkwright has recently installed NOAA weather radios at the sites of its large customers.
• *Supporting Climate Monitoring and Research.* While on the one hand climate research is arguably not the domain of insurers and risk managers, Frank Nutter of the Reinsurance Association of America has noted that "it is incumbent upon us to assimilate our knowledge of the natural sciences with the actuarial sciences." Among the most proactive steps to date, in 1993 thirteen insurers (including the five US companies AIG, AON Corp., Chubb, Employers Re, General Re, and Tillinghast-Towers Perrin) formed the Risk Prediction Initiative in Bermuda. The members collectively fund a $1.3 million annual research program aimed at better understanding the variability of risks posed by hurricanes. Other goals include improving actuarial methods for assessing weather-related risks to account for climate changes and climate processes extending beyond the period of claims histories. Some insurers are hiring staff climatologists.
• *Making Green Investments.* Norway's largest insurance company and investor has launched the Storebrand Scudder Environmental Value Fund. This mutual fund is currently valued at about $135 million, and includes companies that pass an environmental screening test that includes nine indicators for pollution, resource use, and sound environmental management. Other founding insurer investors are Anova, Gerling, Orkla, Trygg-Hansa, and Swiss Re.
• *Capitalizing on Energy-Efficiency and Renewable Energy.* Energy consumption is the largest contributor to greenhouse-gas emissions. Of particular interest, there is a class of energy-efficient and renewable energy technologies that also help mitigate insurance risks. For example, highly insulated roofs are less susceptible to destructive ice dam formation, and energy-efficient refrigeration equipment minimizes the likelihood of food or pharmaceutical spoilage following

power outages. Similarly, solar power systems can help keep the lights on following natural disasters. Arkwright Mutual Insurance Company has promoted the use of energy-efficient torchiere light fixtures in college dormitories, because the traditional halogen-based versions of these fixtures are a known source of fires. DPIC—the country's second largest insurer of architects and engineers—has provided premium credits for their insureds who practice commissioning (an energy-driven quality assurance process aimed at preempting liability claims). This family of loss-prevention methods is notable in that it is cost-effective on the basis of energy savings alone (i.e., before counting loss prevention benefits), and thus reductions in greenhouse gas emissions come as a “no-regrets” dividend to insurers and society.

Pull outs:

Actuaries and risk managers have not only the analytical skills to evaluate the quality and bias of research methods, but also the commitment to understand the parameters underlying risk in as much analytical detail as necessary.

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